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The chapter on artifact manufacturing begins from a sound base of modern experience, as the author notes, "... with the exception of some types of hammer, ... all the tools required for the experiments ... were already in my existing kit of blacksmith's tools." It was relatively simple to reproduce the ancient blacksmith's work in the environment of a modern smithy.

Sim's experiments emphasize the importance of preserving craft knowledge that has been passed down. Sim approached the problem with flawed preconceptions he got from modern metalworking technology. When that failed, he was forced to re-invent knowledge that every Roman [and later] bloomsmith knew from the first day of his apprenticeship. Today's blacksmiths, as Sim discovered, suffer a special disadvantage because they "have little or no experience of wrought iron, much less bloom iron." Archaeologists who are not also blacksmiths, he learned, may not be able to appreciate "the many subtleties of iron working."

When he moved on to toolmaking, the author became as nearly as possible a replica Roman blacksmith, imitating the output of a legionary smith, converting wrought iron billets into standard tools, which included a hammer, a stylus, nails, disposable weapons, a pattern-welded sword and chain mail. Except for fastidious note-taking, the researcher reproduced the toolmaker's work as nearly as possible. Each Roman tool was reproduced and each step was documented.

Sim documented the time required, the metal and fuel consumed, and the most likely production sequence of each tool. Such economic data provided by experimental archaeology may need correction to account for the experimenter's lack of craft experience. The first bolt head took 8 minutes 38 seconds, while the second was made in 5 minutes 12 seconds. The author notes, "With practice at this particular item, a production time of under 5 minutes per item is possible."

Each toolmaking process is illustrated with particularly good line drawings, including a diagram of a pole lathe and sketches comparing Roman and modern methods for fixing a haft to a hammer.

Debris, particularly hammer scale, is found on the floor of any ironworking site, modern or ancient. Archaeologically, hammer scale may be the only process residue that survives on the ground. Sim asked if such wastes in the archaeological record could be used to distinguish the ironworking activities that occurred on a site. Toward this end, he examined scale from his own bloomsmithing and toolmaking sites, an archaeological site, and five modern working blacksmith forges.

Shape, size, and chemical composition were considered in distinguishing the scale samples. All hammer scale, the author concluded, can be described as flakes, spheres, black slag and white lumps. Using XRF analysis, Sim identified chemical differences between residues from bloomsmithing, toolmaking, and welding. Bloomsmithing hammer scale is richer in silicon than the scale from toolmaking, and the scale around a welding forge contained the least silicon, presumably because the purest iron was processed there.

Hammer welding, which requires very high temperatures, produced the smallest spherical waste, indicating that this class of scale might be a useful indicator of working temperatures in

any forge site. While the mixtures of particles differed among the processes, the evidence was insufficient to generalize predictions of what might be found in future archaeological sites. This is a line for future research.

Residues from modern blacksmith shops reflected the varieties of materials, other than iron, that might be encountered in the course of today's repair and fabrication business. Such residues include copper, solder, lead, brass, and wood shavings. Similar mixtures might be found archaeologically in a village blacksmith's shop, as opposed to a production shop on a military camp.

The discussion of hammer scale will be most useful to the largest number of archaeologists, because this is the most common residue in a smithy, regardless of the activity that was performed there. Internal geography of a blacksmith shop may be defined by hammer scale.

Generally, according to Sim, scale is found in the form of a circle, centered just forward and to the left of a right-handed blacksmith. Distribution maps of scale quantities will be particularly useful for interpreting blacksmith shops from which all the furnishings have been removed. Without such guidance in the interpretation of scale, the only reported floor plan details frequently have been locations of the anvil base and the fire. Knowing how to find the blacksmith's working stance, we can now recreate the activity areas within a site.

A glossary at the end will be useful for non-blacksmiths.

Overall, this book represents an excellent apology for the usefulness of experimental archaeology, if that ever was in doubt. The study fills a gap in the archaeology of ironmaking technology, but its lasting contribution will undoubtedly be its prospective role as a guide for archaeologists seeking to interpret ironworking sites.

Seriation, Stratigraphy and Index Fossils: The Backbone of Archaeological Dating. Michael J. O'Brien & R. Lee Lyman, Kluwer Academic / Plenum Publishers: New York, 1999. xi+253pp., 67 figures, 5 tables, index. Price \$59.95, \$40.00 (hardbound). ISBN 0-306-46152-8.

Reviewed by Andrew R. Millard, Department of Archaeology, University of Durham, South Road, Durham, DH1 3LE, UK.

I offered to review this book because I hoped it would be a useful textbook for our master's course in Applied Chronometry as well as for undergraduate teaching. I also hoped to learn something of the state-of-the-art in seriation. My first hope was fulfilled, but not as expected; the second was disappointed.

This book is not an account or textbook of recent research in seriation and stratigraphy. Rather it is an account of the fundamental principles of relative dating illustrated mostly by their development within Americanist archaeology in the period 1910-1950. However it is not merely an historical account, but tries to set out rigorously the principles involved within the context of an explicitly evolutionary approach to archaeology.

Chapter 1 introduces the basic topic of how time is measured and how different methods yield different measures of time as ordinal (relative), interval (absolute) or cyclical. A very emphatic argument is made that we should recognise what type of measure we are using and not confuse them. The chapter ends with a brief introduction to how *we create* units to measure time, which leads on to the next chapter.

Chapter 2 considers a fundamental component of seriation: the type. We all think we know what a type is, but this treatment is both clear and thought provoking. It also offers a very clear reminder, based on the work of James A. Ford in the 1930s that “artifact types are nothing more than tools created and used to order archaeological materials”. This is a very important point: types are created, ideational units, and we should not treat them as if they were empirical, directly observable units.

Having thus laid the foundations of the nature of time and of typology, the book moves on in the next four chapters to consider methods of seriation, stratigraphy, and cross-dating. Chapter 3 introduces the fundamental concepts of seriation. O’Brien and Lyman argue that all seriation is dependent on two sorts of continuity being present in the set of types under consideration: historical continuity and heritable continuity. Historical continuity is the similarity of objects due to chronological closeness and is presumed to reflect heritable continuity, which is similarity due to “common descent”. Many parallels are drawn with biological evolution, particularly the need to be aware of homologous and analogous traits. The authors also refer to the “debate over whether similar archaeological phenomena owe their similarity to common heritage or adaptive convergence”. Although in Darwinian evolution analogous traits arise by adaptive convergence, it is not clear to me that convergence of traits in archaeological types is necessarily adaptive, as decorative features may converge for cultural rather than adaptive reasons. Inheritance amongst types also differs from biological inheritance, as a type may inherit traits from more than one preceding type, but a species cannot inherit traits from more than one preceding species. These important caveats are overlooked, presumably because of the authors’ strong precommitment to a Darwinian evolutionary paradigm for archaeology. The final part of Chapter 3 introduces phyletic seriation where artifacts are ordered by changes in attributes. One example given is the developmental continuum from Clovis points into Dalton points, which can be obscured by the assignment of all points to one or other of these *ideational* units.

Chapter 4 discusses frequency and occurrence seriation. Frequency seriation is the form that is familiar to most archaeology students, where a successful seriation may be represented by a “battleship” curve. Less common, but at times useful, is occurrence seriation where only the presence or absence of types is used to seriate. Three basic requirements are identified: (i) assemblages of similar duration, the shorter the better, (ii) assemblages from the same local area, and (iii) assemblages all from one cultural tradition. There is an excellent discussion of frequency seriation, its assumptions and limitations, but, because of the authors’ self imposed historical limits to their discussion, computer-based statistical methods for seriation are not discussed. This is one of the major omissions

of the book, as such techniques dominate current application of seriation, and can help to deal with one of the limits of manual seriation, namely that “chronologically useful types cannot ‘reappear’ at a later date” (p. 29) (see, for example, Buck & Sahu 2000). The chapter ends with a discussion of the temporal resolution of seriation methods, where the authors note that “types that produce good seriations are likely to have a relatively neutral adaptive value”, which again confirms my suspicion that a selectionist view is not useful in seriation and that some of the discussion in Chapter 2 is irrelevant.

“Superposition and stratigraphy: measuring time discontinuously” is the title of Chapter 5. Of this 44-page chapter, 31 pages are devoted to an historical account of the development of stratigraphic excavation, which while relevant, and showing up some general misconceptions, seems to be overlong. In their discussion of this topic the authors reiterate a point which all archaeologists must remember: you cannot necessarily equate the time of deposition (which *is* related to stratigraphy) to the time of creation of the artifacts found in the deposit. That this needs to be drilled into all of us archaeologists is demonstrated on p. 146, where the authors do just this, albeit with a geological example. In the example, a river deposits material eroded from 80Ma old limestone, which is covered by local organic debris over a century and in turn the river covers this with material eroded from 235Ma old limestone. If we excavated at this point “we would have three strata in chronological order relative to when they were deposited but the ages of the sediments themselves, from bottom to top would be 80 million years old, roughly 50 years old and 235 million years old.” No! The sediments *qua* sediments have ages equal to their ages of deposition. Even the particles in the first and third sediments cannot be said to have the ages quoted, as one cannot necessarily equate the time of deposition of sedimentary limestones to the time of creation of the particles in them. A much clearer discussion of this sort of geological process with a terminology which might be adapted to archaeological situations is given by Pell *et al.* (1997). More importantly the authors assume throughout that “artifacts usually occur within non-cultural, or natural sediments” (p. 147). This may be true in North American prehistory, but try telling that to a European medievalist or the excavator of a tell! Archaeological stratigraphy frequently is *not* equivalent to geological stratigraphy, as Harris (1989) has shown, and this chapter is much the poorer for ignoring this fact. The chapter concludes with a reminder that stratigraphic excavation gives a discontinuous measure of time with breaks at stratigraphic boundaries.

Cross-dating and index fossils are the subject of another lengthy historical treatment in Chapter 6. Again comparison is made with biostratigraphy, which uses very similar techniques. O’Brien and Lyman also manage to fall into another of their own traps. The trap was set back in Chapter 2 where we are told that species are “collections of individuals that look similar and share the same isolating mechanisms” (p. 52), implying that a species is an ideational construct just like an archaeological type. Further we should not conflate an individual artefact (or animal) with its type (or species) as that is conflation of empirical and ideational units (p. 51). The trapper is trapped

on p.204 where “biological species do often interbreed”. Individuals from two species may interbreed, but ideational units do not breed!

Chapter 7 is a summary of the book with some wider philosophical discussion, as the title indicates: “Final thoughts on archaeological time: a clash of two metaphysics”. This discussion looks at science *versus* common sense in archaeology, and partly addresses the perennial question of if and when archaeology is a science. This is followed by the résumé of the book with a series of rather opaque references to the essentialist-materialist paradox in archaeology (no attempt is made to define either term). I suspect one needs to have read O’Brien’s (1996) edited volume *Evolutionary Archaeology* to fully comprehend them.

Overall this is a useful book. Its strengths lie in its clear discussion of time and typology, its explicit consideration of the assumptions of relative dating techniques, and its emphasis on precise use of language. Its weaknesses lie in its strongly Americanist bias, which will put off some readers from elsewhere in the world, and its historical perspective which limits its consideration of methodology. Omissions of major significance are the lack of an account of the use of correspondence analysis for seriation, and the absence of any reference to a quarter of a century’s work on specifically archaeological stratigraphy since the seminal work of Harris (1975). With these caveats I shall be recommending it to my students, because there is little else on the subject, and nothing else as good.

This book has shown me that we need another book on this subject, one with the same rigorous approach, but which includes more recent developments. In the meantime, the final paragraph sums up why you should read this one:

“One could adopt the attitude that none of this matters since radiometric dating has alleviated our chronological problems but knowledge of how methods of relative dating work is crucial to successful archaeological research absolute radiometric methods are no panacea; one needs to evaluate and test the results obtained and relative dating methods provide one source of test implications the only way to [do] archaeology is to retain and to understand and *supplement* with radiometric dating techniques the relative dating methods we have discussed here” (p. 226, original emphasis).

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The Maritime Heritage of the Cayman Islands. Roger C. Smith, University Press of Florida: Gainesville, 2000. xxii +230 pp., 82 figures, 9 maps, 3 appendices, index. Price: \$49.95 (cloth). ISBN: 0-8130-1733-4

Reviewed by William E. Boyd, School of Resource Science & Management, Southern Cross University, New South Wales 2480, Australia

This book is an elegant account of exploration and discovery. It is an account which opens with a description of the joys of fieldwork – surely one of the vitalizing aspects of archaeological and geoarchaeological research – and an introduction to the Cayman Islands Project which has run since the late 1970s. The Project represents the author’s research under the auspices of the Institute of Nautical Archaeology at Texas A&M University, and focuses on the site recording of archaeological sites on the three islands of Little Cayman, Cayman Brac and Grand Cayman. The book is a synthesis of that work. The story of the history and archaeology uncovered by the Project illustrates the process of academic research, and the reminds us of the intimate links between work in the field, the laboratory and the library. It is also, first and foremost, an account of historic exploration and discovery, of a place at once at the centre of things and yet isolated from the mainstream. This is a place discovered by Christopher Columbus in 1503 and subsequently inhabited by pirates, fishermen and seaman, a place of a great abundance of sea turtles and the crocodiles which gave their name to the islands, and a place of great riches and equally great disasters. While the author does not claim to present a complete picture of the history of the Cayman Islands, he does explore key elements of the maritime history and culture of these islands, reviewing the emergence of the distinctive Caymanian culture.

The book comprises six chapters, appended with three transcripts of significant historical documents. The chapters chart the paths of exploration and discovery woven through the book, opening with an introduction to the Cayman Islands Project itself (the Preface and Chapter 1). Chapter 2, “Founded Upon the Seas”, provides a traditional regional and descriptive geography of the Islands. This geography places the islands and the project in context, and is replete with discussions of the cartographic history of the islands, past and present land-and sea-use, the naming of the islands and of the place names of the islands, and, of course, the hurricanes which in many ways have played a major role in shaping the culture of the islands (of which more below). Chapter 3 cuts to the first of three central themes in the history of the Cayman Islands. Under the title “Shoal of Sea Turtles”, this chapter describes the abundance of this natural resource, charting the growth and demise of a rich environmental resource extraction industry. We are told, at the close of this chapter, that “today, many Europeans and most Americans have never tasted the unique flavor of sea turtle ... [and] ... Caymanians no longer set sail on turtling voyages”. This is very much the tale of an industry and associated culture now almost at extinction, along with the very resource, so abundant in the past, that formed the